Experimental Program to Stimulate Competitive Research

Mat Varma
Director, DOE EPSCoR
Office of Basic Energy Sciences

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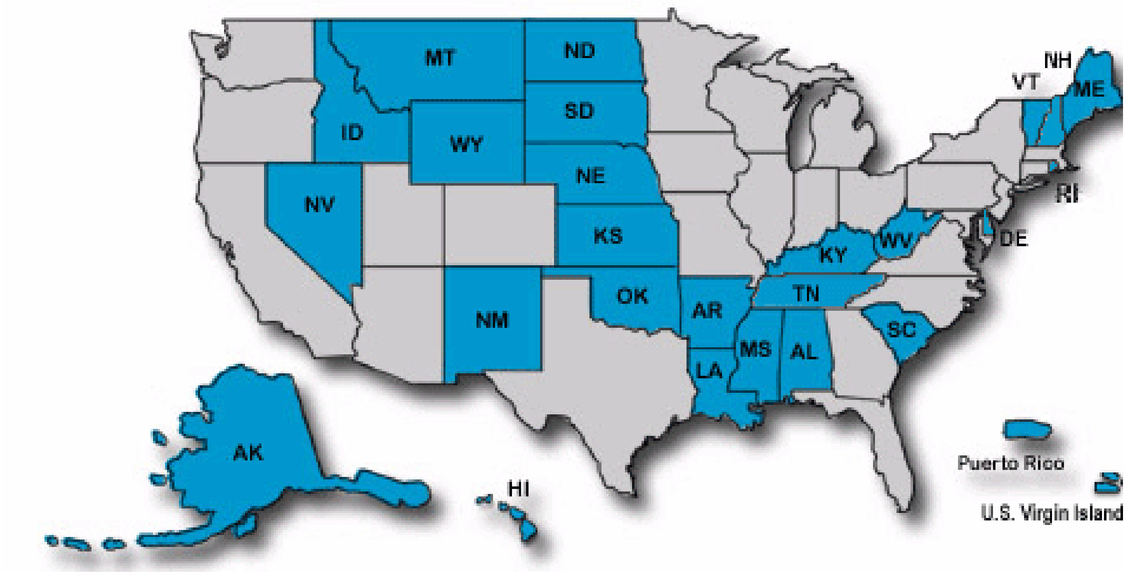
EPSCoR Program History

The Experimental Program to Stimulate Competitive Research (EPSCoR) was started by the NSF in 1979 to broaden the geographical distribution of federal funding for academic research and development.

Map shows States eligible for NSF program and their year of entry into the program. DOE made the same states as NSF eligible for its program. During FY91-FY94 DOE funded planning grants to give states experience in developing competitive proposals.



Total DOE eligible entities 27

FY1980	FY1985	FY1987	FY1992	FY2000	FY2002	FY2004	FY2006
Arkansas Maine Montana South Carolina West Virginia	Alabama Nevada Puerto Rico Vermont Kentucky North Dakota Oklahoma Wyoming	Idaho Louisiana Mississippi South Dakota	Kansas Nebraska	Alaska	Hawaii New Mexico	Tennessee Delaware Virgin Islands	New Hampshire Rhode Island

EPSCoR Program History

In FY1991, the EPSCoR program was started in six additional agencies: DOD, DOE, EPA, NASA, NIH, and USDA. Since then, interagency coordination has been provided by the EPSCoR Interagency Coordinating Committee (EICC).

Table below shows the funding distribution by Department/Agency

Department/Agency	**Funding (million)** **FY 2004**	**FY 2005**	**FY 2006**
NSF	95.0	94.4	94.0
NIH	215.0	222.0	222.0
DOD	9.8	14.1	9.2
USDA	16.5	14.5	0.0
DOE	**7.7**	**7.6**	**7.3**
NASA	10.0	12.0	4.6
EPA	2.5	2.4	0.0
Total	356.5	367.0	337.1

Most funding is for NIH and NSF. DOE funding is stable and modest.

Portfolio

- **Breadth of DOE programmatic research areas and participating DOE Laboratories supported by the EPSCoR Program**
  - **Research Areas Supported**

Advanced Scientific Computing	Environmental Sciences
Biological Sciences	Fusion Energy Sciences
Chemical Sciences	High Energy and Nuclear Physics
Coal and Power Systems	Materials Sciences
Defense Sciences	Transportation Technologies

  - **National Laboratories Participating**

Argonne National Lab. (ANL)	National Energy Technology Lab. (NETL)
Brookhaven National Lab. (BNL)	National Renewal Energy Lab (NREL)
Fermi National Accelerator Lab. (FNAL)	Oak Ridge National Lab. (ORNL)
Idaho National Lab (INEEL)	Pacific Northwest National Lab. (PNNL)
Lawrence Berkeley National Lab. (LBNL)	Princeton Plasma Physics Lab. (PPPL)
Lawrence Livermore National Lab. (LLNL)	Sandia National Laboratories (SNL)
Los Alamos National Lab. (LANL)	Thomas Jefferson National Lab. (TJNL)

Distinguishing Features

- **The Experimental Program to Stimulate Competitive Research (EPSCoR) was started by the NSF in 1979 to broaden the geographical distribution of federal funding for academic research and development. In FY 1991, the program was started in DOE under Congressional direction.**
- **There are at present 25 states (AK, AL, AR, DE, HI, ID, KS, KY, LA, ME, MS, MT, NE, NH,NM, NV, ND, OK, RI,SC, SD, TN, VT, WV, WY) and Commonwealth of Puerto Rico (PR) and US Virgin Islands (VI) eligible to participate.**
- **Program funds basic research in energy-related programmatic areas of interest to DOE by awarding Implementation Grants and Laboratory Partnership Grants.**
- **Implementation Grants**
  - One applications per state
  - Coordinated research area of interest to state and DOE
  - At least 50 percent state matching funds
  - One research cluster (group of scientists working on a common theme) per application
  - Program Coordination and Human Resource Development closely coupled with research cluster
  - Maximum funding of $750,000 per year for up to six years

Distinguishing Features - Continued

- **Laboratory Partnership Grants:**
  - Collaborative research with national laboratory required
  - Training of students and young faculty at the laboratory encouraged
  - Visit by Lab scientist to EPSCoR states also encouraged
  - Individual principal investigator originated
  - Research area of interest to DOE and states
  - Application endorsed by the state coordinator
  - DOE program office and DOE laboratory priority review
  - 10% cost share by the states required and nominal cofunding by program offices recommended
  - No EPSCoR program funds to the national laboratories
  - One to three year grants
  - Maximum funding $150,000 per year

National and International Standing

- National standing: This is one of the seven National programs addressing the research competitiveness of the designated states. It represents the Nation's only program in collaboration with EPSCoR states in energy-related research.
- Laboratory Partnership Grants are allowing EPSCoR State investigators to work closely with the DOE National Laboratories in conducting collaborative research and training students.

Relevance

- The DOE EPSCoR Program has three main objectives:
  - To enhance the research capabilities of designated states
  - To conduct competitive energy-related research
  - To develop science and engineering human resources to meet current and future needs in energy-related areas
- These objectives are attained through the award of Implementation Grants and Laboratory Partnership Grants.

Major Historical Impacts

- The number of states participating in Implementation Grants has increased from six in FY 1997 to fourteen in FY 2004.
- Initiated Laboratory Partnership Grants in FY 1998 to increase the number of states participating in the program. Nineteen states are participating in FY 2004.
- EPSCoR State investigators are conducting competitive research in collaboration with world class scientists at DOE National Laboratories, using state-of-the-art research facilities. Nearly all DOE National Laboratories are collaborating.

FY 2004 Highlights

- 10 New Laboratory Partnership Grants Initiated.
- Almost 100% Participation from Program Offices in cofunding, most National Laboratories participating
- DOE/EPSCoR Workshop with NSF at ANL(2004). Approximately 180 individuals from DOE National Labs, EPSCoR States and other Federal Agencies participated in this workshop.
- Strengthened Implementation Grants by Coupling Human Resource Development with Research Clusters.
- Three renewal Implementation grants were reviewed and funded for final three years.
- Sixteen new applications for implementation grant were peer reviewed. This review resulted in initiation of four new grants.

Challenges

- Maintain balance between the Implementation Grants and Laboratory-Partnership Grants.
- Increase participation to 100% of eligible states. In FY 2004 nineteen states received EPSCoR funding.
- Adjust the program to include new entities that were added to the program in FY 2004: Delaware, Tennessee and US Virgin Islands and in FY2006: New Hampshire and Rhode Island.
- Reduced the state match to 50 percent from 100 percent match for Implementation grants.
- Reduced the number of implementation grant applications states can submit from two to one.
- Adjust to uncertainty of budgets from year to year.

Program Evolution

- **Implementation Grants: Number of research clusters per grant reduced to one from about five. Human resource development coupled closely with the research cluster.**
- **In FY 2002, the following changes took effect in Implementation Grants:**
  - Two applications will be allowed per state (but still only one award)
  - One research cluster per application
  - Program Coordination and Human Resource Development coupled with research cluster
- **In FY 2005 to improve quality of applications only one application per state will be allowed**
- **Laboratory Partnership Grants: Maximum funding per grant $150K per year.**
- **Achieved balance between Implementation Grants and Laboratory Partnership Grants.**
- **Nominal cofunding by other DOE Program Offices initiated: Shows interest in the EPSCoR program.**

Interactions

- BES
  - Jointly funding projects with Materials Sciences and Engineering Division and Chemical Sciences, Geosciences, and Biosciences Division.
- SC
  - Jointly funding projects with following offices:
    ASCR, BER, FES, HEP, NP
- DOE
  - EE - Office of Transportation Technology
  - DP - Office of Defense Science
  - FE - Office of Natural Gas and Petroleum Technology, Office of Coal and Power Systems
- Interagency
  - Program coordinated through EPSCoR Interagency Coordinating Committee (EICC)
  - Agencies represented: DOD, EPA, NASA, NIH, NSF, USDA

Funding Summary

Dollars in Thousands

	FY 2004	FY 2005	FY 2006 Request
Total	7,673	7,643	7,280
SBIR	221*	220*	210*

***SBIR contribution. Not included in the Funding Summary Total.**

Recent Highlights

Basic Energy Sciences

Neutron Scattering of Thin Films and Interfaces:

Neutron scattering is undergoing a revolution due to vast improvements in sensitivity and resolution made possible with upgrades at the High Flux Isotope Reactor (HFIR) and the construction of the Spallation Neutron Source. Neutrons make it possible to make unique measurements of magnetic materials which are inaccessible with other techniques. Magnetic materials are currently used in the information storage industry for hard drives and in the near future for nonvolatile magnetic random access memories. Neutron scattering techniques are necessary for understanding the fundamental properties of the materials. To improve these techniques a neutron analyzer with horizontal focusing was developed at the University of Alabama. This focusing analyzer is being implemented in a neutron spectrometer at HFIR. The spin structure of antiferromagnetic films and oxide materials was studied with neutron scattering techniques. Improvements in sample fabrication and characterization techniques are resulting in obtaining a more comprehensive understanding of the relationship between structure and magnetism in epitaxial antiferromagnetic films. This type of fundamental materials science research should aid in increasing the storage density, miniaturizing storage units, increasing data rates and reducing the cost per bit in storage devices
(GaryMankey, University of Alabama).

Enhanced Chemical Ordering in Ilmenite-Hematite Magnetic Semiconductors:

This study demonstrated the enhancement of the magnetic moments of $FeTiO_3(1-x)/Fe_2O_3(x)$ semiconductor ceramic samples through irradiation with 40 MeV protons. The magnetic moment is directly related to the chemical order in the crystal structure. Thus, it is inferred that the proton irradiation reduces defects in these semiconductor ceramics. This effect allows for production of high-moment magnetic semiconductors for spin electronic applications. Moreover, this technique could lead to improved material properties in other systems, such as composite materials with thermally sensitive components like organic layers or metallic multilayers (R Pandey, University of Alabama).

Carbon nanotube-supported nanoparticle catalysts:

Nanometer-sized metal particles are extremely active
chemically because of their high surface-to-volume ratios. Scientists at the University of Idaho have developed methods of depositing and stabilizing nanometer-sized platinum group metals on surfaces of carbon nanotubes in supercritical fluid carbon dioxide. Uniformly distributed monometallic and bimetallic nanoparticles with narrow size distributions are formed on surfaces of carbon nanotubes using this method. The carbon nanotube-supported Pd and Rh nanoparticles are far more effective than commercial carbon-based Pd and Rh catalysts for hydrogenation of olefins and aromatic compounds. These new nanoscale catalysts are currently being tested as electrocatalysts for low temperature polymer electrode fuel cells applications (Peter Griffiths, University of Idaho).

Mechanistic investigations of Silane and Chlorocarbon addition to low-valent palladium species and their application to catalysis:

Homogeneous catalysts play an important role in the industrial production of chemicals, the synthesis of
pharmaceuticals, and the processing of petroleum feed stocks. Fundamental understanding of the mechanism of catalytic reactions allows for the tailoring and optimization of catalysts. This project has been able to generate and observe extremely reactive low-valent palladium species through nanosecond laser flash photolysis. Recent results imply that Si-H oxidation addition to palladium proceeds through exotic sigma complex intermediates. Similar sigma complex intermediates are likely important for catalytic transformations of petroleum feed stocks (Mark Fink, Tulane University).

Biological and Environmental Research

Structural Biology and Computational Biology:

The ability of an individual to form a clot primarily depends on the generation of a protein called thrombin. The process is aided by another protein called factor Va. Faculty and students at the University of Vermont have recently solved the 3-dimensional structure of bovine factor Vai, a fragment of factor Va, which provides an essential look at how this protein may function to regulate thrombin production. Due to its similarity to factor VIII, one of the proteins responsible for hemophilia, knowledge of this structure may lead to the development of new pharmaceuticals for the treatment of this devastating disease as well as other thrombotic disorders such as stroke (Susan Wallace, University of Vermont).

Carbon Sequestration in Agriculture:

Using tower eddy covariance flux measurements of carbon, gross primary production (GPP) and ecosystem respiration (Re) of irrigated maize and soybean fields were quantified. The growing season cumulative GPP of maize was 1744 g C m-2, larger than most natural ecosystems except a few very productive forests. Cumulative ecosystem respiration of maize was 1154 g C m-2. The cumulative GPP and Re of soybean were both substantially smaller than maize (966 and 826 g C m-2, respectively). Such information is essential for an accurate analysis of the potential of these Important agroecosystems in mitigating rising atmospheric carbon dioxide concentration (Shashi Verma, University of Nebraska).

Radiative Effects of Hygroscopic Aerosols in the Stable Nocturnal Boundary Layer with Implications for Climate Trends:

The reduction of the diurnal temperature range (DTR) primarily due to nocturnal warming is the most significant signal in the Recent climate record, yet its cause is not clear. Faculty at the University of Alabama in Huntsville is examining the increase in downwelling radiation due to condensational growth of hygroscopic aerosols in the nocturnal boundary layer. Previous high-resolution boundary layer modeling studies showed that this effect can increase downwelling radiation by 13-20 W m-2. Thus, regional and global changes in aerosol burdens might make this effect a significant climate forcing factor in explaining DTR damping. This could further lead to better understanding of the greenhouse effect (R McNeider, UAH).

Recent Highlights

Advanced Scientific Computing Research

High performance anisotropic diffusion equation solver:

Members of this project have developed a unique algorithm that, when used in conjunction with advanced medical images, can predict communication pathways in the brain. In particular, the algorithm uses solutions of the anisotropic diffusion equation to help predict converging or branching fiber tracts. Prior methods for predicting pathways stall when they reach branch points (or at the very best do not proceed down all the branches). The new algorithm easily predicts and proceeds down all branches, and could prove crucial in helping to non-invasively diagnose the onset of various brain disorders. The anisotropic diffusion equation solver requires modules from a specialized toolkit, a set of high performance computational routines developed at various DOE national laboratories (Eric Carlson, University of Alabama).

Ubiquitous Computing and Monitoring System (UCoMS) for Discovery and Management of Energy Resources:

The wireless network is a key component to realize the UCoMS objectives, which require geographic location information for effective communications. The Louisiana scientists have developed a novel self-configurable positioning technique for such a network, wherein multiple nodes serve as the landmarks for constructing a specific coordinate system. Any other node then contacts the landmarks to determine its own coordinates. This technique establishes consistent coordinates for all nodes, and it is independent of the Global Positioning System (GPS). Once tuned with respect to GPS, this coordinate system enhances performance by efficiently guiding traffic and services over the network (Michael Khonsari, Louisiana State University).

High Energy Physics

Discovering the Higgs Bosons:

The most important goal for the Fermilab Tevatron Run II and the CERN Large Hadron Collider (LHC) is the investigation of the mechanism by which elementary particles acquire mass—the discovery of the favored Higgs bosons or another mechanism. The group at the university of Oklahoma has investigated the prospects for the discovery of a neutral Higgs boson ($\phi 0$) produced with one bottom quark $bg \to b\phi 0$ followed by Higgs decays into muon pairs within the framework of the minimal supersymmetric standard model. Promising results are found for the CP-odd (A0) and the heavier CP-even (H0) Higgs bosons. This discovery channel with one bottom quark greatly improves the LHC discovery potential beyond the inclusive channel $pp \to \phi 0 \to \mu+\mu- +X$. The muon discovery channel will provide a good opportunity for a precise reconstruction of the Higgs boson masses (Chung Kao, University of Oklahoma).

Top Physics with B-Quark tagging at D0:

Kansas state university (KSU) high energy physics scientists are conducting research in implementing a method for detecting very heavy "b-quarks" produced in collisions of protons with anti-protons at Fermilab's Tevatron. This work helps D0 (a major high energy physics experiment and collaboration) exploit its high precision silicon microstrip tracker, a device for which KSU and the University of Kansas designed, built, and tested many key components. KSU developed "CSIP b-tagger" enables detailed studies of the very heaviest known fundamental objects, the top quark. Further understanding of top quark properties may shed light on fundamental mechanisms in nature for generating mass (Tim Bolton, KSU).

Nuclear Physics

Designing and building a polarized frozen spin target at Thomas Jefferson National Laboratory (JLab):

Ordinary matter is made of protons and neutrons called nucleons and their exact structure is still unknown. Polarized beams and targets are essential tools in the study of the nucleon. Nucleons are like small magnets and can be collectively oriented by strong magnetic fields (~5T) at low temperatures (<1K). A state of the art polarized frozen spin target has been designed and being built at JLab. It will be used to look for so called "missing resonances" (nucleon states which are predicted but have not been seen so far). This target will assist in conducting cutting edge research in nuclear physics (C Djalali, University of South Carolina).

Collision physics:

Ultraperipheral relativistic collisions of heavy ions (the two ions pass in close proximity but do not overlap) generate electromagnetic fields with extremely large energy densities. Particle production from these fields probes our fundamental understanding of electromagnetic interactions. Scientists at Creighton University have analyzed data collected with the STAR detector from 200 GeV/nucleon collisions of gold nuclei at the Relativistic Heavy Ion Collider. Electromagnetic production of rho mesons in ultraperipheral collisions has been observed. Knowledge of how the production probability depends on factors such as the momentum of the particles and their angle to the beam line can help distinguish between competing theoretical models (Janet Seger, Creighton University).

Recent Highlights

Renewable Energy and Efficiency

Utilization of Biomass:

The researchers at Jackson State University are working to improve the amount of ethanol that can be produced from Southern Pines. Acid hydrolysis is being developed for conversion of biomass into a liquid process stream (hydrolyzate) that can be either directly fermented into ethanol or further processed by enzymatic conversion into a then more fermentable stream used to make ethanol. Southern Pine acid hydrolyzate containing sugars and inhibitors, such as furans and phenolics, was treated with a weak anion resin and laccase immobilized on kaolinite. Fermentation of the sugars in the treated hydrolyzate resulted in significantly higher ethanol production levels than those achieved with the untreated hydrolyzate.

Interphase Analysis and Control in Fiber Reinforced Thermoplastic Composites:

Over the past decade considerable effort has been expended to develop a new generation of vehicles that are lighter and more fuel-efficient than today's vehicles. Targets include reduction in overall weight of approximately 40%, primarily achieved through lighter body and chassis materials. This research is of significance in that it will help develop the necessary science base to allow more complete exploitation of PMCs (Polymer Matrix Composites) having thermoplastic matrices, resulting in even lighter vehicles. One important scientific study has been to understand the extent of crystallinity as a function of formation conditions in fiber reinforced thermoplastic composites (Jon Kellar, SD School of mines and technology).

Defense Programs

Robust Radiography Devices:

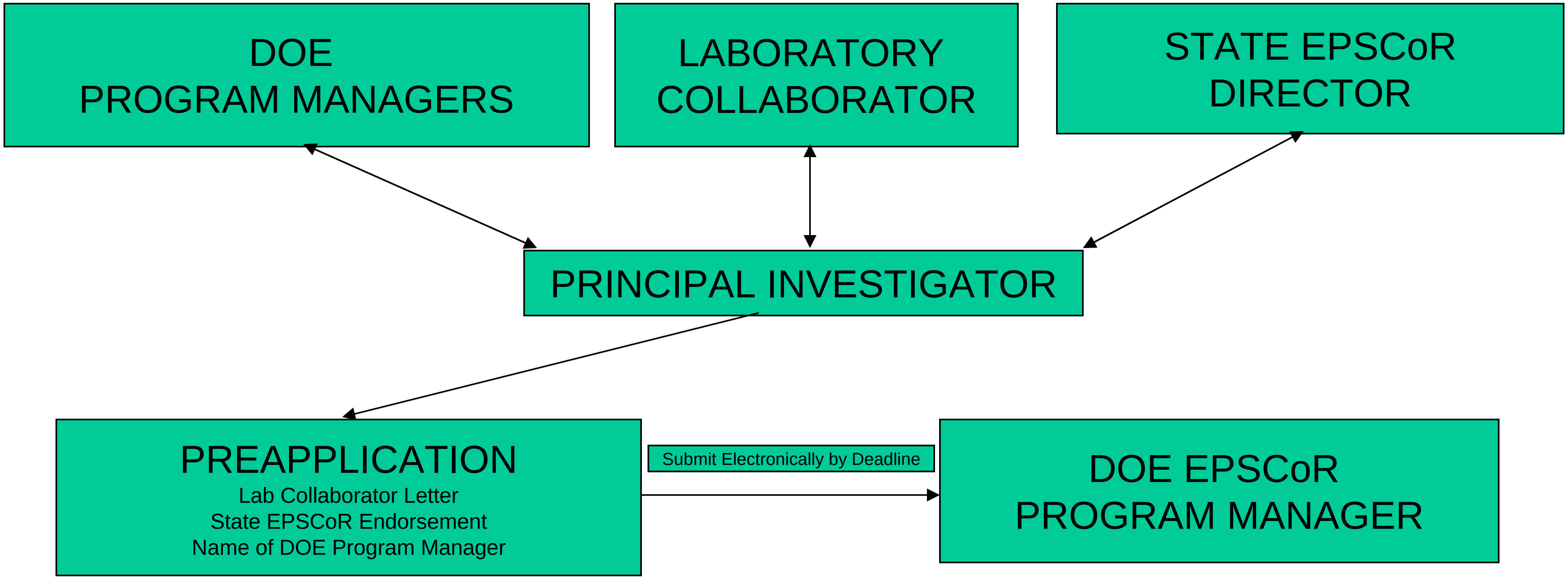
Development of robust x-ray radiographic devices is an important need for many DOE national security applications, which require an improved understanding of electrical breakdown in high voltage insulators. To address this challenge, the Nevada Shocker (a 540,000 V pulse power machine) has been developed, and is now in operation, at the Pulsed Power Laboratory at the University of Nevada Las Vegas. Also developed were a number of sensors and a novel calibration technique to absolutely quantify the sensor data, which measures the strength and motion of the radially propagating electromagnetic pulse which interrogates the insulator under test. This will lead to basic understanding of electrical properties of insulators that are utilized in nuclear weapons program (Robert Schill, University of Nevada, Las Vegas).

Fossil Energy

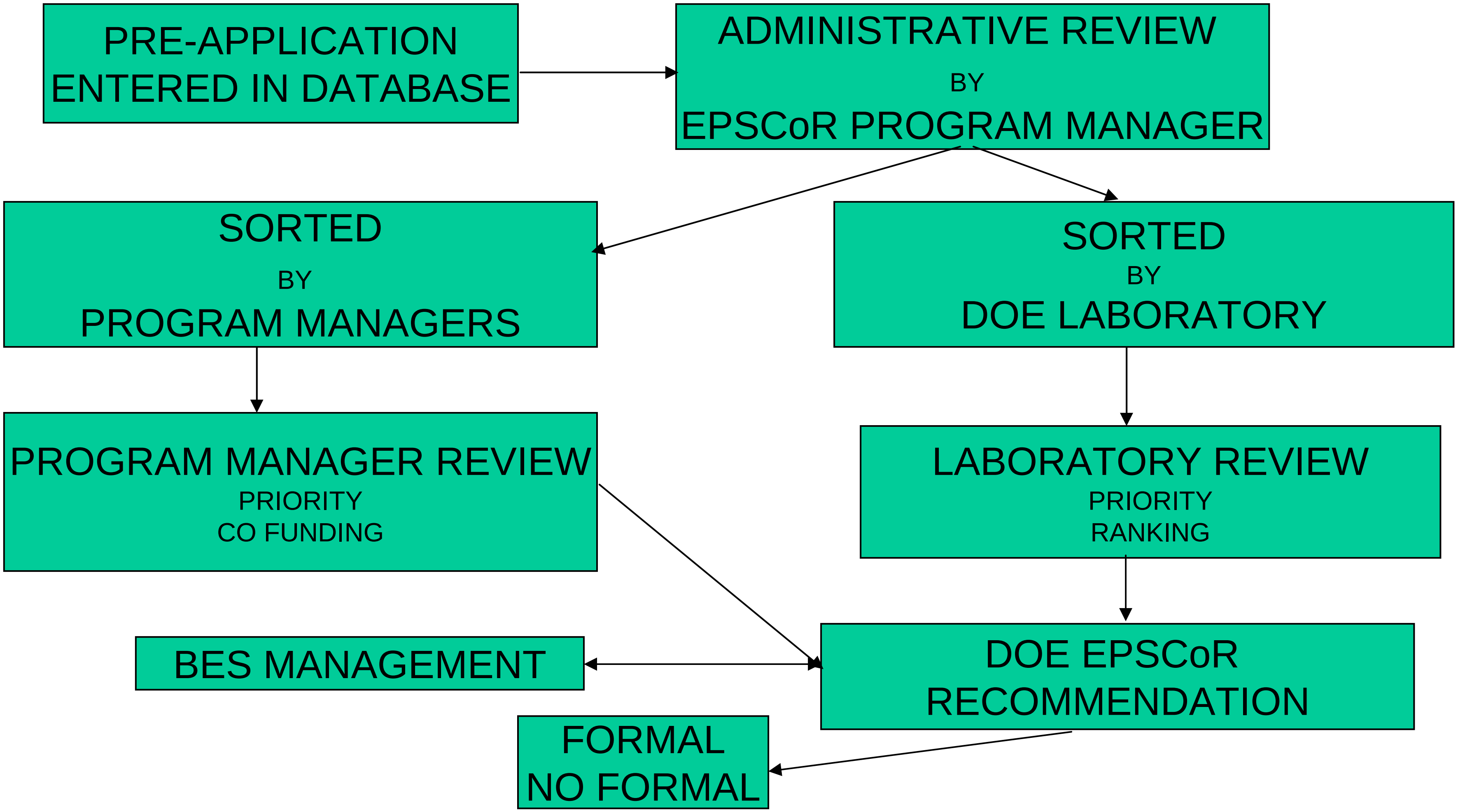
Distributed Generators:

Research by West Virginia University's Advanced Power and Electricity Research Center (APERC) shows that distributed generators (DGs) such as fuel cells and microturbines can be used to "balance" electricity supply and demand at the distribution network level, opening the possibility for distribution networks to operate autonomously from the transmission system, in effect becoming "microgrids." For such microgrids to work, the DG must be able to track electricity demand in real time, producing more or less electricity to exactly meet the current demand or risk losing the network causing a blackout. Today's DGs are not able to continuously vary the amount of electricity they produce. To address this issue, APERC researchers have developed control design algorithms that would allow DGs to adjust their output and provide energy balancing in a distribution system (Richard Bajura, West Virginia University).

A Journey of Pre-Application



A Journey of Pre-Application



A Journey of Formal Application